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Forest Health Protection

Pacific Southwest Region
Northeastern California Shared Service Area

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To: District Ranger, Mt. Hough Ranger District, Plumas National Forest

Subject: Insect and Disease Evaluation of the Lone Rock Forest Health and Recreation Area Improvement Project (FHP Report NE14-04)

Summary

At the request of Alex Yiu, Assistant District Silviculturist, Mt. Hough Ranger District, Danny Cluck, Forest Health Protection Entomologist, conducted a field evaluation of the Boulder and Lone Rock Campgrounds, Antelope Lake Day Use Area and surrounding forests on June 9, 2014. The objective of this visit was to evaluate current stand conditions, determine the impacts of forest insects and diseases on forested recreation areas and discuss treatment alternatives. Recommendations provided in this report will assist in the formulation of silvicultural prescriptions aimed at limiting the amount of bark beetle-caused tree mortality during the current drought by reducing stand density. Alex Yiu participated in the evaluation.

Key findings:

- Lone Rock and Boulder Campgrounds and the Antelope Lake Day Use Area are extremely overstocked with Jeffrey and ponderosa pines and are at risk to high levels of bark beetle-caused tree mortality during the current and future droughts.
- Jeffrey pine beetle, western pine beetle and mountain pine beetle are currently causing elevated tree mortality in stands within and adjacent to the project area.
- Thinning is proposed to minimize the amount of bark beetle-caused tree mortality by removing infested trees and reducing stocking to levels that are less susceptible to successful bark beetle attacks.
- Current bark beetle activity, severe drought and existing stand conditions support the use of Categorical Exclusion #14 [36 CFR 220.6(e)(14)] to expedite treatments that can reduce the amount of bark beetle-caused mortality.

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Description of the project area

Antelope Lake is located approximately 9 miles southeast of Janesville, CA at an elevation of approximately 5,000 feet. Annual precipitation ranges between 20 and 25 inches. Forests consist of Jeffrey pine (*Pinus jeffreyi*), ponderosa pine (*Pinus ponderosa*), white fir (*Abies concolor*), Douglas-fir (*Pseudotsuga menziesii*) and lodgepole pine (*Pinus contorta var. murrayana*) by order of abundance in most of the stands. Average density within most of the proposed treatment area is well above recommended levels that would reduce the risk of successful bark beetle attacks in ponderosa pine, Jeffrey and lodgepole pine stands.

Management objectives

The Lone Rock Forest Health and Recreation Area Improvement Project aims to reduce the amount of bark beetle-caused tree mortality in one of the last forested areas around Antelope Lake. Pine stands will be thinned to a range of 80 to 150 sq. ft. /acre of basal area. Campground stands will retain relatively higher stocking based on local site conditions. The residual stands will be more open, increasing the amount of available soil moisture and sunlight for individual trees.

Forest insect and disease conditions

Western pine beetle (*Dendroctonus brevicomis*), Jeffrey pine beetle (*Dendroctonus jeffreyi*) and mountain pine beetle (*Dendroctonus ponderosae*) were observed in their preferred host tree species (ponderosa pine, Jeffrey pine and lodgepole pine respectively) within the recreation area (Figures 1 – 4). Affected trees included several large old growth Jeffrey and ponderosa pine that were dying from bark beetle attacks sustained the previous summer in an area just north of the campgrounds. Bark beetle activity appears to be increasing from previous years based on the number of new fading trees versus older dead. No significant forest diseases were observed within the project area.

Figures 1 & 2. Jeffrey pines killed by Jeffrey pine beetle adjacent to project area.

Stand conditions and drought

Tree densities for most forest stands within and adjacent to the Lone Rock Forest Health and Recreation Area Improvement Project are well above recommended levels for reducing the risk of bark beetle-caused tree mortality especially when considering the impacts of drought and also of soil compaction from foot and vehicle traffic on site carrying capacity.

High stand density combined with drought conditions cause extreme moisture stress in individual trees, thus reducing their ability to fend off bark beetle attacks. Healthy pines defend themselves by producing resins that drown attacking beetles. When trees are stressed, resin pressure is reduced and the probability of successful bark beetle attack in increased. High stand density may also improve conditions for the bark beetle pheromone communication system, which facilitates mass attacks on individual trees, by concentrating the pheromone plume under a full canopy.

Bark beetle-caused mortality has increased throughout California due in part to drought conditions that have persisted for the past three years. Bark beetle-caused mortality of pine species has also increased in many areas with higher levels of mortality occurring in overstocked stands. Dense stands of pines are also susceptible to large group killing of trees during extended periods of drought.

Figures 3 & 4. Dying ponderosa pine (left) attacked by pine engraver and western pine beetles and lodgepole pine (right) killed by mountain pine beetle within project area.

In the campgrounds, the average basal area (BA) is 273 sq. ft. /acre and the stand density index (SDI) is 459. In the day-use area, the average BA is 231 sq. ft. /acre and the SDI is 452. These SDI values are well above the bark beetle limiting SDI of 365 for ponderosa pine. SDI 365 is considered the upper management zone above which bark beetle outbreaks are likely to occur (Oliver 1995). Egan (2011 and 2012) reported that Jeffrey pine resilience thresholds were consistent with experimental studies within ponderosa pine systems based on a detailed study of a Jeffrey pine beetle outbreak in the Lake Tahoe area. This Jeffrey pine beetle outbreak which occurred from 1991 to 1996 followed the severe drought period of 1987-1992. Stands with the highest mortality (>150 trees/acre) were above SDI 350. Oliver suggests that ponderosa pine stands be maintained below SDI 230 to minimize the level of western pine beetle-caused mortality. Egan suggests Jeffrey pine stands be maintained below SDI 210 or 125 sq. ft. /acre to minimize Jeffrey pine beetle-caused mortality. Stands that were between SDI 111 and 210 experienced much lower mortality during the outbreak (14 trees/acre). No mortality was reported for stands that were at or below SDI 110.

Considerations for thinning treatments within the campgrounds and surrounding area

Trees in the Antelope Lake campgrounds, similar to most forested campgrounds, are exposed to additional stress factors that can compromise their health and vigor. Firewood collecting sometimes leads to tree wounding from hatchets and saws, foot and vehicle traffic from campers can result in increased soil compaction and root damage, and the desire for screening between campsites and increased canopy cover can result in overstocking of both understory and overstory trees.

Soil compaction in campgrounds can predispose pines to bark beetle attacks. Compaction can reduce the water holding capacity of the soil. Compacted soils also tend to suffocate roots, limiting the available oxygen that is necessary for root growth and survival. Damaged and unhealthy roots cannot provide the upper portions of the tree with the water and nutrients it requires to maintain its natural defenses. Root damage is a long-term problem that may not reveal itself until several years after the damage has occurred. In order to minimize future soil compaction and root damage, campers should be confined to specific travel corridors from campsites to restrooms, water sources, and specific recreation areas. It is especially important to divert and limit foot and vehicle travel and restrict excavation for roads, trails and utilities as much as possible from the root zones of trees.

High stand density in both campgrounds is also playing a role in predisposing trees to bark beetle attacks. Excessive competition for limited water and nutrients puts stress on individual trees and reduces their ability to maintain an adequate defense system. Overstocked stand conditions may persist over time with limited bark beetle caused mortality until triggered by drought or other factors. Bark beetle-caused mortality within a campground can result in a dramatic reduction in stocking, especially in the larger size classes, and an increase in the number of hazard trees that must be removed.

To increase health and vigor and reduce the risk of future bark beetle caused tree mortality, stands in both campgrounds and surrounding areas should be thinned to a basal area appropriate for the site. When determining the carrying capacity of the site the effects of soil compaction should be considered as site quality may be reduced. In addition, where compaction exists, trees may not respond as expected after thinning treatments. In general, to reduce the susceptibility to future bark beetle caused tree mortality, stands should be thinned to densities that are 80% or less of "normal", effectively reducing tree competition for limited water and nutrients. In terms of SDI, stands should be maintained below SDI 210 to reduce susceptibility. Opening up the canopy may also disrupt the pheromone communication system by creating convection currents and air turbulence through increases in soil temperature (Bartos and Amman 1989).

When planning thinning treatments, it should be recognized that the target stocking level is an average to be applied across the landscape and some variability may be desired. Individual high value trees, such as mature pine, as well as pure stands of younger ponderosa and Jeffrey pine should benefit by having the stocking around them reduced to lower levels. In addition, thinning can decrease the need to enter stands to conduct salvage operations, decrease the amount of fuel loading and reduce the number of hazard trees.

It is important to know that when cutting trees in recreation areas, all conifer stumps greater than 3" in diameter must be treated with a registered borate compound (FSM R5 Supplement 2300-92-1 modified by FSH R5 Supplement 3409.11-2010-1) to reduce the probability of infection by *Heterobasidion occidentale* and *H. irregulare*. The causal agents of Heterobasidion root disease (formerly referred to as annosus root disease).

Use of CE #14

The Mt. Hough Ranger District is proposing that this thinning project be accomplished using the National Environmental Policy Act (NEPA), Categorical Exclusion #14 [36 CFR 220.6(e)(14)] *Commercial and non-commercial sanitation harvest of trees to control insects or disease not to exceed 250 acres, requiring no more than ½ mile of temporary road construction, including removal of infested/infected trees and adjacent live uninfested/uninfected trees as determined necessary to control the spread of insects or disease*.

In my opinion, extremely overstocked forest conditions and bark beetle activity observed within and adjacent to the Lone Rock Forest Health and Recreation Area Improvement Project combined with the current severe drought support the use of this categorical exclusion.

Potential for funding through the Western Bark Beetle Program

Forest Health Protection may be able to assist with funding, including NEPA activities, for thinning and removing green material from overstocked areas within the Lone Rock Forest Health and Recreation Area Improvement Project. Thinning treatments that reduce stand density sufficient to lower the risk to bark beetle-caused mortality would meet the minimum requirements for Western Bark Beetle Program funding and would be supported by this evaluation. If you are interested in this competitive funding please contact me for assistance in developing and submitting a proposal.

If you have any questions regarding this report and/or need additional information please contact Danny Cluck at 530-252-6431.

/s/ Danny Cluck

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Insect and Disease Information

Jeffrey pine beetle

The Jeffrey pine beetle is the principle bark beetle found attacking Jeffrey pine, which is its only host. It is a native insect occurring from southwestern Oregon southward through California and western Nevada to northern Mexico. The beetle normally breeds in slow-growing, stressed trees. The beetles prefer trees which are large, mature, and occur singly rather than in groups. Yet when an epidemic occurs, the beetle may attack and kill groups of trees greater than 8 inches in diameter, regardless of age or vigor. Often the beetle infests lightning-struck or wind-thrown trees, but does not breed in slash.

Evidence of Attack

Presence of the beetle is usually detected when the foliage changes color. The color change of the foliage is related to the destruction of the cambium layer by the beetle. Generally, the top of the crown begins to fade in a slow sequence, with the needles turning from greenish yellow, to sorrel, and finally to reddish brown. By the time the tree is reddish brown, the beetles have usually abandoned the tree. Another sign of beetle attack is large, reddish pitch tubes projecting from the bark of the infested tree. If examined carefully, pitch tubes can be detected on infested green trees prior to crown fade. Jeffrey pine beetles have a distinctive "J" shape egg gallery pattern on the inner bark. Larval mines extend across the grain and end in open, oval-shaped pupal cells.

Life Stages and Development

The Jeffrey pine beetle is one of the larger pine bark beetles in California. The beetle has a 4 life stages, egg, larva, pupa, and adult. The adults are stout, cylindrical, black, and approximately five-sixteenths of an inch long when mature. The egg is oval and pearly-white. The larva is white, legless, and has a yellow head. The pupa is also white but is slightly smaller than the mature larva. The life cycle is normally completed in one year in the northern part of the range, but in the southern part, two generations per year may occur. The principle period of attack is in June and July, but attacks also are frequent in late September and early October. Similar to other *Dendroctonus* species, Jeffrey pine beetles use pheromones that attract other beetles to a tree, causing a mass attack that tends to overcome the tree's natural resistance. Blue stain fungi are associated with Jeffrey pine beetle attacks and aid in overcoming the tree’s defenses.

Conditions Affecting Outbreaks

Normally the Jeffrey pine beetle is kept in check by its natural enemies, climatic factors and the resistance of its host. Similar to other *Dendroctonus* species, the availability of suitable host material is a key factor influencing outbreaks. Healthy trees ordinarily produce abundant amounts of resin, which pitches out attacking beetles. When deprived of moisture, or stressed by other factors such as disease or fire injury, trees cannot produce sufficient resin flow and become susceptible to successful beetle attacks.

Western pine beetle

The western pine beetle, *Dendroctonus brevicomis*, has been intensively studied and has proven to be an important factor in the ecology and management of ponderosa pine throughout the range of this host species (Miller and Keen 1960). This insect breeds in the main bole of living ponderosa pine larger than

about 8 inches dbh. Normally it breeds in trees weakened by drought, overstocking, root disease, dwarf mistletoe or fire. Adult beetles emerge and attack trees continuously from spring through fall. Depending on the latitude and elevation, there can be from one to four generations per year.

Evidence of Attack

Initial attacks are made about mid-bole and subsequent attacks fill in above and below. Pitch tubes are formed on the tree trunk around the entry holes. The pitch tubes are red-brown masses of resin and boring dust. Relatively few, widely scattered, white pitch tubes usually indicate that the attacks were not successful and that the tree should survive. Pheromones released during a successful attack attract other western pine beetles. Attacking beetles may spill over into nearby apparently healthy trees and overwhelm them by sheer numbers.

Life Stages and Development

These beetles pass through the egg, larval, pupal and adult stages during a life-cycle that varies in length dependent primarily upon temperature. Adults bore a sinuous gallery pattern in the phloem and the female lays eggs in niches along the sides of the gallery. The larvae are small white grubs that first feed in the phloem and then mine into the middle bark where they complete most of their development. Bluestain fungi, introduced during successful attacks, contribute to the rapid tree mortality associated with bark beetle attacks.

Conditions Affecting Outbreaks

Outbreaks of western pine beetle have been observed, and surveys made, in pine regions of the West since 1899 (Hopkins 1899; cited in Miller and Keen 1960). An insect survey completed in 1917 in northern California indicated that over 25 million board feet of pine timber had been killed by bark beetles. Information from surveys initiated in the 1930s indicates that there were enormous losses attributed to western pine beetle around that time. During the 1930's outbreak, most of the mortality occurred in stands of mature or overmature trees of poor vigor (Miller and Keen 1960). Group kills do not typically continue to increase in size through successive beetle generations as is typical with Jeffrey pine beetle. Rather, observations indicate that emerging beetles tend to leave the group kill area to initiate new attacks elsewhere.

The availability of suitable host material is a key condition influencing western pine beetle outbreaks. In northeastern California, drought stress may be the key condition influencing outbreaks. When healthy trees undergo a sudden and severe moisture stress populations of western pine beetle are likely to increase. Healthy trees ordinarily produce abundant amounts of resin, which pitch out attacking beetles, but when deprived of moisture, stressed trees cannot produce sufficient resin flow to resist attack. Any condition that results in excessive demand for moisture, such as tree crowding, competing vegetation or protracted drought periods; or any condition that reduces that ability of the roots to supply water to the tree, such as mechanical damage, root disease, or soil compaction, can cause moisture stress and increase susceptibility to attack by the western pine beetle. Woodpeckers and predaceous beetles are natural control agents when beetle populations are low.

Mountain pine beetle

The mountain pine beetle, *Dendroctonus ponderosae*, attacks the bole of ponderosa, lodgepole, sugar and western white pines larger than about 8 inches dbh. Extensive infestations have occurred in mature

lodgepole pine forests. Group killing often occurs in mature forests and young overstocked stands of ponderosa, sugar and western white pines.

Evidence of Attack

The first sign of beetle-caused mortality is generally discolored foliage. The mountain pine beetle begins attacking most pine species on the lower 15 feet of the bole. Examination of infested trees usually reveals the presence of pitch tubes. Pitch tubes on successfully infested trees are pink to dark red masses of resin mixed with boring dust. Creamy, white pitch tubes indicate that the tree was able to "pitch out" the beetle and the attack was not successful. In addition to pitch tubes, successfully infested trees will have dry boring dust in the bark crevices and around the base of the tree. Attacking beetles carry the spores of blue-staining fungi which develop and spread throughout the sapwood interrupting the flow of water to the crown. The fungi also reduces the flow of pitch in the tree, thus aiding the beetles in overcoming the tree. The combined action of both beetles and fungi causes the needles to discolor and the tree to die.

Life Stages and Development

The beetle develops through four stages: egg, larva, pupa and adult. The life cycle of the mountain pine beetle varies considerably over its range. One generation per year is typical, with attacks occurring from late June through August. Two generations per year may develop in low elevation sugar pine. Females making their first attacks release aggregating pheromones. These pheromones attract males and other females until a mass attack overcomes the tree. The adults bore long, vertical, egg galleries and lay eggs in niches along the sides of the gallery. The larvae feed in mines perpendicular to the main gallery and construct small pupal cells at the end of these mines where they pupate and transform into adults.

Conditions Affecting Outbreaks

The food supply regulates populations of the beetle. In lodgepole pine, it appears that the beetles select larger trees with thick phloem, however the relationship between beetle populations and phloem thickness in other hosts has not been established. A copious pitch flow from the pines can prevent successful attack. The number of beetles, the characteristics of the tree, and the weather affect the tree's ability to produce enough resin to resist attack. Other factors affecting the abundance of the mountain pine beetle include nematodes, woodpeckers, and predaceous and parasitic insects. As stand susceptibility to the beetle increases because of age, overstocking, diseases or drought, the effectiveness of natural control decreases and pine mortality increases.